

What is claimed:

1        1. ~~A printer control circuit, which is a dedicated printer control hardware circuit~~  
2 disposed between an upper apparatus and a printer, comprising:

3        a halftoning circuit for performing a halftone process to convert high-resolution  
4 raster data, for a first image element, that are transmitted from said upper apparatus into first  
5 low-resolution raster data; and

6        an image completion circuit for obtaining low-resolution raster data for a complete  
7 print image employing second low-resolution raster data, for a second image element, that  
8 are transmitted from said upper apparatus, and said first low-resolution raster data, for said  
9 first image element, that are transmitted from said halftoning circuit.

1        2. A printer control circuit according to claim 1, wherein said first image  
2 element is an illustration, and said second image element constitutes characters and graphics.

1        3. A printer control circuit according to claim 1 or 2, wherein said high-  
2 resolution raster data for said first image element, which are transmitted from said upper  
3 apparatus, are expressed using an upper apparatus display color system that differs from a  
4 printer display color system that is employed by said printer; wherein said second low-  
5 resolution raster data for said second image element, which are transmitted from said upper  
6 apparatus, are expressed using said printer display color system; and wherein said halftoning  
7 circuit also performs color conversion for said high-resolution raster data for said first image  
8 element that are transmitted from said upper apparatus display color system to said printer  
9 display color system.

1 ~~4. A printer control circuit according to claim 1, wherein for said low-resolution~~  
2 raster data for said complete print image said image completion circuit changes pixel order  
3 for interlaced printing.

1 5. A printer control apparatus according to claim 1, wherein a memory is  
2 provided for said image completion circuit, and wherein to obtain said low-resolution raster  
3 data for said complete print image said first low-resolution raster data for said first image  
4 element and said second low-resolution raster data for said second image element are  
5 superimposed and are written in said memory.

1 6. A printer control apparatus according to claim 5, wherein, when said image  
2 completion circuit is writing one of said first low-resolution raster data for said first image  
3 element and said second low-resolution raster data for said second image element, said  
4 image completion circuit holds the other of said first and second low-resolution raster image  
5 data that are to be written to said memory.

1 7. A printer control apparatus according to claim 5, wherein said high-  
2 resolution raster data for said first image element and said second low-resolution raster data  
3 for said second image element are sequentially transmitted by said upper apparatus; and  
4 wherein, when said image completion circuit recognizes that raster data both for said first  
5 and for said second image elements have been rasterized, said image completion circuit  
6 increments a vertical address for designating a location in said memory for writing said  
7 raster data, and superimposes and writes, at the same vertical address in said memory, said  
8 raster data for said first and said second image elements for the same raster.

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8. A printer control apparatus according to claim 7, wherein, for a raster having said first image element or said second element not available, a raster end command for instructing raster termination of a pertinent image element is transmitted by said upper apparatus, and wherein, upon receiving said raster end command, said image completion circuit acknowledges said raster termination of said pertinent image element and obtains the same results without requiring null data for said pertinent image element that is being written in said memory.

9. A printer control apparatus according to claim 5, wherein, in order to develop said low-resolution raster data for said complete print image, said memory has a capacity that is large enough to store all the raster data in a range that is equivalent to one where the print head of said printer covers two paths; and wherein, while said image completion circuit reads raster data stored in said memory that said print head requires for the current path, said image completion circuit writes raster data in said memory until the last raster that said print head requires for the next path is reached.

10. A printer control apparatus according to claim 5, wherein said image completion circuit writes raster data to said memory in an OR write mode; and wherein said image completion circuit reads raster mode from said memory in a clear read mode during the last reading cycle for each raster, and in a normal read mode during a reading cycle other than the last reading cycle.

11. A printer comprising:  
a dedicated hardware circuit for processing image data that are received from an upper apparatus, said dedicated hardware circuit including  
a halftoning circuit for performing halftoning for high-resolution raster data for a first image element received from said upper apparatus and obtaining first low-resolution

6 raster data; and

7 an image completion circuit for obtaining low-resolution raster data for a complete  
8 print image from second low-resolution raster data that are received from said upper  
9 apparatus for a second image element, and said first low-resolution raster data that are  
10 received from said halftoning circuit for said first image element,  
11 wherein printing is performed using said low-resolution raster data that are obtained  
12 by said dedicated hardware circuit for said complete print image.

1 12. A printer according to claim 11, wherein said first image element is an  
2 illustration, and said second image element constitutes characters and graphics.

1 13. A printer according to claim 11 or 12, wherein said high-resolution raster  
2 data for said first image element, which are transmitted from said upper apparatus, are  
3 expressed using an upper apparatus display color system that differs from a printer display  
4 color system that is employed by said printer; wherein said second low-resolution raster data  
5 for said second image element, which are transmitted from said upper apparatus, are  
6 expressed using said printer display color system; and wherein said halftoning circuit also  
7 performs color conversion for said high-resolution raster data for said first image element  
8 that are transmitted from said upper apparatus display color system to said printer display  
9 color system.

1 14. A printer according to claim 11, wherein for said low-resolution raster data  
2 for said complete print image said image completion circuit changes pixel order for  
3 interlaced printing.

1 15. A printer according to claim 11, wherein a memory is provided for said  
2 image completion circuit, and wherein to obtain said low-resolution raster data for said

3 ~~complete print image said first low-resolution raster data for said first image element and~~  
4 said second low-resolution raster data for said second image element are superimposed and  
5 are written in said memory.

1 16. A printer according to claim 15, wherein, when said image completion circuit  
2 is writing one of said first low-resolution raster data for said first image element and said  
3 second low-resolution raster data for said second image element, said image completion  
4 circuit holds the other of said first and second low-resolution raster image data that are to be  
5 written to said memory.

1 17. A printer according to claim 15, wherein said high-resolution raster data for  
2 said first image element and said second low-resolution raster data for said second image  
3 element are sequentially transmitted by said upper apparatus; and wherein, when said image  
4 completion circuit recognizes that raster data both for said first and for said second image  
5 elements have been rasterized, said image completion circuit increments a vertical address  
6 for designating a location in said memory for writing said raster data, and superimposes and  
7 writes, at the same vertical address in said memory, said raster data for said first and said  
8 second image elements for the same raster.

1 18. A printer according to claim 17, wherein, for a raster having said first image  
2 element or said second element not available, a raster end command for instructing raster  
3 termination of a pertinent image element is transmitted by said upper apparatus, and wherein,  
4 upon receiving said raster end command, said image completion circuit acknowledges said  
5 raster termination of said pertinent image element and obtains the same results without  
6 requiring null data for said pertinent image element that is being written in said memory.

1 19. A printer according to claim 15, wherein, in order to develop said low-

2 / resolution raster data for said complete print image, said memory has a capacity that is large  
3 enough to store all the raster data in a range that is equivalent to one where the print head of  
4 said printer covers two paths; and wherein, while said image completion circuit reads raster  
5 data stored in said memory that said print head requires for the current path, said image  
6 completion circuit writes raster data in said memory until the last raster that said print head  
7 requires for the next path is reached.

1 20. A printer according to claim 15, wherein said image completion circuit writes  
2 raster data to said memory in an OR write mode; and wherein said image completion circuit  
3 reads raster mode from said memory in a clear read mode during the last reading cycle for  
4 each raster, and in a normal read mode during reading cycle other than the last reading cycle.

1 21. A printing system comprising:  
2 an upper apparatus;  
3 a printer; and  
4 a dedicated printer control hardware circuit located in between said upper apparatus  
5 and said printer,  
6 said dedicated hardware circuit including  
7 a halftoning circuit for performing halftoning for high-resolution raster data for a  
8 first image element received from said upper apparatus and obtaining first low-resolution  
9 raster data, and  
10 an image completion circuit for obtaining low-resolution raster data for a complete  
11 print image from second low-resolution raster data that are received from said upper  
12 apparatus for a second image element, and said first low-resolution raster data that are  
13 received from said halftoning circuit for said first image element.

1 22. A printing system according to claim 21, wherein said first image element is

2 an illustration, and said second image element constitutes characters and graphics.

1 23. A printing system according to claim 21 or 22, wherein said high-resolution  
2 raster data for said first image element, which are transmitted from said upper apparatus, are  
3 expressed using an upper apparatus display color system that differs from a printer display  
4 color system that is employed by said printer; wherein said second low-resolution raster data  
5 for said second image element, which are transmitted from said upper apparatus, are  
6 expressed using said printer display color system; and wherein said halftoning circuit also  
7 performs color conversion for said high-resolution raster data for said first image element  
8 that are transmitted from said upper apparatus display color system to said printer display  
9 color system.

1 24. A printing system according to claim 21, wherein for said low-resolution  
2 raster data for said complete print image said image completion circuit changes pixel order  
3 for interlaced printing.

1 25. A printing system according to claim 21, wherein a memory is provided for  
2 said image completion circuit, and wherein to obtain said low-resolution raster data for said  
3 complete print image said first low-resolution raster data for said first image element and  
4 said second low-resolution raster data for said second image element are superimposed and  
5 are written in said memory.

1 26. An upper apparatus, for a printing system for outputting image data to be  
2 printed by a printer, that outputs high-resolution raster data for a first image element  
3 included in a print image and low-resolution raster data for which halftoning has been  
4 processed for a second image element included in said print image.

1 27. An upper apparatus according to claim 26, wherein said first image element

2 is an illustration, and said second image element constitutes characters and graphics.

1 28. An upper apparatus according to claim 26, which expresses said high-  
2 resolution raster data for said first image element using an upper apparatus display color  
3 system that differs from a printer display color system that is employed by said printer, and  
4 which expresses said low-resolution raster data for said second image element using said  
5 printer display color system.

1 29. An upper apparatus according to claim 26, which sequentially transmits said  
2 high-resolution raster image for said first image element and said low-resolution raster data  
3 for said second image element, and which, for a raster having said first image element or  
4 said second image element not available, transmits a raster end command for instructing  
5 raster termination of a pertinent image element.

1 30. A computer-readable recording medium on which is stored a computer  
2 program for use in a computer, said computer constituting an upper apparatus, for a printing  
3 system for outputting image data to be printed by a printer, that outputs high-resolution raster  
4 data for a first image element included in a print image and low-resolution raster data for  
5 which halftoning has been processed for a second image element included in said print  
6 image.